

**TENDER DOCUMENT NO. REN/RES/004/RC/2011-12**  
**SPECIFICATIONS**

**1) TECHNICAL SPECIFICATIONS FOR SPV SYSTEMS**

**A) SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LANTERN SYSTEMS**

**I. DEFINITION**

A Solar Photovoltaic Lantern is a lighting system consisting of a lamp, battery and electronics, all placed in a suitable housing, made of metal, plastic or fiberglass, and PV module. The battery is charged by electricity generated through the PV module. The lantern is basically a portable lighting device suitable for either indoor or outdoor lighting, covering a full range of 360 degrees. A lighting device, which provides only unidirectional lighting, will not be classified as a solar lantern in the present context.

**II. DUTY CYCLE**

The solar lantern should provide a minimum of three hours of lighting per day under average daily solar radiation conditions of 5 KWh / sq.m. on a horizontal surface. The actual duration of lighting may vary depending on the location, season, etc.

**III. MODELS**

The solar lantern should conform to one of the following models:

<b>Sr. No.</b>	<b>Model</b>	<b>Lamp</b>	<b>Battery Capacity AT C/20 Rate</b>	<b>PV Module Rating</b>
<b>12 VOLT MODELS</b>				
	MODEL II-A	CFL 7 W	12 V, 7.00 AH	10.0 to 11.9 Wp
	MODEL II-B	CFL 7 W	12 V, 7.00 AH	12.0 to 14.0 Wp

**IV. LAMP**

- (a) (FOR 12V) - CFL 7 W.
- (b) Battery Model.
- (c) The battery will be sealed maintenance free lead acid type.
- (d) The Capacity of the battery will be a minimum of 7.0 AH at 12 V at C/20 discharge rate at 27°C.
- (e) Eighty percent of the rated battery capacity should be between the low voltage and high voltage cut-off points.

## **V. ELECTRONICS**

- i. The inverter will be of quasi sine wave/sine wave type with a crest factor less than 1.7 and the frequency in the range of 20-35 KHz. Half-wave operations is not acceptable.
- ii. The overall efficiency of the control electronics should be at least 80%.
- iii. No blackening or reduction in the lumen output by more than 10% should be observed after 1000 ON / OFF cycles (two minutes ON and four minutes OFF is one cycle).
- iv. The idle current (i.e. the current consumed when the lamp is switched OFF and no charging is in progress) should not be more than 1 ma.
- v. The PCB containing the electronics should be capable of solder free installation and placement.
- vi. Electronics should operate at 12 V or 6 V (depending upon the model) and should have temperature compensation for proper charging of the battery throughout the year. However, systems not having the temperature compensation facility would also be allowed.

## **VI. PV MODULE**

- (i) The wattage range of the PV modules as given in III (Models) above should be at 16.40 Volts for 12 V Models (8.7 Volts for 6 V Models) under standard test conditions (STC). The open circuit voltage of the PV modules under STC should be at least 21.0 Volts for 12 V Models (11.0 Volts for 6 V Models).
- (ii) The module should preferably have an arrangement (stand) for mounting at the optimum angle in the direction facing the sun.
- (iii) In case of thin film solar cell modules, the specified values refer to the power output after the initial degradation.
- (iv) The terminal box on the module should have a provision for opening for replacing the cable, if required.
- (v) A strip containing the following details should be laminated inside the module so as to be clearly visible from the front side:
  - a) Name of the Manufacturer or distinctive Logo.
  - b) Model or Type No.
  - c) Serial No.

## **VII. ELECTRONICS PROTECTIONS**

- (i) Adequate protection is to be incorporated under no load conditions (e.g. when the lamp is removed and the lantern is switched ON).
- (ii) Battery cut off & reconnects should be provided to protect it against overcharge and deep discharge conditions.
- (iii) A fuse should be provided to protect against short circuit conditions.

- (iv) A blocking diode, preferably a Schottky diode, should be provided as part of the lantern electronics to prevent reverse flow of current through the PV module, in case such a diode is not provided with the module itself.
- (v) Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

### **VIII. OTHER FEATURES**

- (i) The lantern should be provided with 2 LED indicators: a green light to indicate charging in progress and red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
- (ii) A good reliable switch suitable for DC uses to be provided on the lantern. A cable at least 5 meters long should be provided for inter-connection between the module and lantern.
- (iii) The following details should be marked indelibly on the lantern:
  - a) Name of the Manufacturer or Distinctive Logo
  - b) Model Number (this refers to Models indicated in Clause III above)
  - c) Serial Number
- (iv) An Operation, Instruction and Maintenance Manual in English and the local language, should be provided with the solar lantern.
  1. About Photovoltaic
  2. About solar lantern
  3. About P.V. module
  4. About CFL
  5. About battery
  6. Clear instructions about mounting of PV module
  7. About electronics
  8. About charging and significance of indicators
  9. Do's and Don'ts
  10. Clear instructions on regular maintenance and trouble shooting of the lantern.
  11. Name and address of the person or service Centre to be contacted in case of failure or complaint.
- (v) Components and part used in the solar lantern should conform to the BIS specifications, wherever such specifications are available and applicable.
- (vi) The PV module will be warranted for a minimum period of 10 years from the date of supply and the lantern (including the battery) will be warranted for a minimum period of five year from the date of supply. The Warranty Card to be supplied with the system must contain the details of the system supplied. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

- (vii) Additional features such as socket for powering another appliance such as a fan or radio may be provided along with the switch. This is however purely optional. If such features are provided, they should not interfere with the independent switching on and off of the lantern.

## B) TECHNICAL SPECIFICATION OF SOLAR HOME LIGHT SYSTEM:

- Definition:** A Solar home system aims at providing solar electricity for operating lights and/or fan or energizing a DC operated portable TV set for specified hours of operation per day.
- Technical Specifications & General Specifications:**

Model	Component	Specifications
<u>Model-1</u> One Light Point	PV Module	1 x 18 W under STC
	Lamp	1 x CFL (9W/11W)
	Battery	1 x 12V, 20AH. Tubular Plate, low maintenance type Lead Acid Battery or VRLA Gel Type
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires / cables, Switches, Operation, instruction and maintenance manual.
<u>Model-2</u> Two Lights	PV Module	1 x 37 W under STC
	Lamp	2 x CFL (9W/11W)
	Battery	1 x 12V, 40AH. Tubular Plate, low maintenance type Lead Acid Battery or VRLA Gel Type.
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires/cables, Switches, Operation, instruction and maintenance manual.
<u>Model - 3</u> 2 Lights & 1 Fan	PV Module	2 x 37 W or 1x74 W under STC
	Lamp	2 x CFL (9W/11W)
	Fan	1 x DC Fan (with wattage less than 20W)
	Battery	1 x 12V, 75AH. Tubular Plate low maintenance type Lead Acid Battery or VRLA Gel Type.
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires/cables, Switches, Operation, instruction and maintenance manual.
<u>Model - 4</u> 4 Lights	PV Module	2 x 37 W or 1x74 W under STC
	Lamp	4 x CFL (9W/11W)
	Battery	1 x 12V, 75AH. Tubular Plate, low maintenance type Lead Acid Battery or VRLA Gel Type.
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires/cables, Switches, Operation, instruction and maintenance manual.

**1) DUTY CYCLE:**

The system should be designed under average daily insolation of 5.5 KWh/ sq.m. on a horizontal surface.

MODELS	AVERAGE HOURS OF OPERATION / DAY
Model -1	1 Lamp, 3 . 4 Hours
Model -2	2 Lamp, 3 . 4 Hours
Model -3	2 Lamp, 2 . 3 Hours, 1 Fan --2 . 3 Hours
Model -4	4 Lamp, 3 . 4 Hours

**2) LAMP:**

- i. The lamps will be of compact fluorescent (CFL) type, either 4 . Pin or 2 . Pin types, with ratings of 9 W or 11 W. For the 4 . Pin type CFL, a suitable pre-heating circuit must be provided.
- ii. The light output from the lamp will be around 550 + 5 % lumens (for 9 W CFL) and 850+ 5 % lumens (for 11 W CFL). Also, please see (iii) of VI given below.
- iii. The lamps will be housed in a weatherproof assembly suitable for indoor use, with a reflector on its back. While fixing the assembly, the lamp will be held in a base up configuration.
- iv. Maximum DC current consumption for an 11W CFL at 12 V will not exceed 1 Amp.
- v. The lamps will conform to relevant BIS standards.

**3) BATTERY:**

- a) Flooded electrolyte type, positive tubular plate, low maintenance lead acid battery, conforming to relevant BIS standards or gel type VRLA.
- b) The battery will have a minimum rating of 12V, 20-40 or 75 Ah (at C/10) discharge rate depending on Model.
- c) 75% of the rated capacity of the battery will be between fully charged and load cut off conditions.

**4) ELECTRONICS:**

- a) The inverter will be of quasi sine wave/sine wave type with frequency in the rage of 20-35 KHz. Half . Wave operation is not acceptable.
- b) The total electronics efficiency will be at least 80%.
- c) No blackening or reduction in the lumen output by more than 10% will be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle).

- d) The idle current consumption will not be more than 10 mA. Electronics will operate at 12 V and will have temperature compensation for proper charging of the battery throughout the year.
- e) Necessary lengths of wires/cables and fuses will be provided.

**5) PV MODULE (S):**

- a) The PV module (s) shall contain mono / multi crystalline silicon solar cells. It is preferable to have certificate for the supplied PV module as per IEC 61215 (revised) specifications or equivalent National or International Standards. In case if the supplied PV module is not a regular PV module of the manufacturer and does not have certificate as per IEC 61215 (revised) specifications, then the manufacturer should have the required certification for at least one of their regular modules. Further, the manufacturer should certify that the supplied module is also manufactured using same material design and process similar to that of certified PV module.
- b) Power output of the module (s) under STC will be a minimum of 18W or 37W or 74W. In case of Model . IV & V either two modules of minimum 37 W output each or one module of 74 W output will be used.
- c) The operating voltage corresponding to the power output mentioned above will be 16.4 V.
- d) The open circuit voltage of the PV modules under STC will be at least 21.0 volts.
- e) The terminal box on the module will have a provision for replacing the cables, if required.
- f) A strip containing the following details will be laminated inside the module so as to be clearly visible from the front side:
  - Name of the Manufacturer or distinctive logo.
  - Model or Type No.
  - Serial No.
  - Year of make.

**6) ELECTRONIC PROTECTION:**

- a) Adequate protection is to be incorporated under no load conditions. e. g. When the lamp is removed and the system is switched ON.
- b) The system will have protection against battery overcharge and deep discharge conditions.
- c) Fuses will be provided to protect against short circuit conditions.
- d) A blocking diode preferably a Schottky type, will be provided as part of the electronics to prevent reverse flow of current through the PV module (s), in case such diode is not provided with the PV module (s).
- e) Full protection against open circuit, accidental short circuit and reverse polarity will be provided.

**7) MECHANICAL COMPONENTS:**

- a) Metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure will have provision to adjust its angle of inclination to the horizontal between 0 ° and 45°, so that the module (s) can be oriented at the specified tilt angle.
- b) A vented, metallic / plastic / wooden box with acid proof corrosion resistance painted metallic box / Polyethylene for outdoor use will be provided for housing the battery.

**8) OTHER FEATURES:**

The system will be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED will glow only when the battery is actually being charged.

There will be a Name Plate on the system which give:

- Name of the Manufacturer or Distinctive Logo.
- Serial Number.

Components and parts used in solar home systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.

The PV module (s)/systems will be warranted as per the clause given in section 7 of part . A of the Tender document. The manufacturers can also provide additional information about the system and conditions of warranty as necessary. The warranty card to be supplied with the system must contain the details of the system supplied as given below:

**9)** An operation, Instruction and Maintenance Manual in English and the local language will be provided with the solar home system. The following minimum details must be provided in the manual:

- a) About Photovoltaic
- b) About solar home system . its components and expected performance.
- c) About PV Module.
- d) About CFL
- e) About Battery.
- f) Clear instructions about erection of pole and mounting of PV module and lamp housing assembly on the pole.
- g) About electronics.
- h) About charging and significance of indicators.
- i) DOs and Don'ts
- j) Clear instructions on regular maintenance and trouble shooting of solar home system.
- h) Name and address of the person or service center to be contacted in case of failure or complaint.

### **C) TECHNICAL SPECIFICATION OF SOLAR STREET LIGHTING SYSTEMS:**

- DEFINITION:**

A stand alone solar photovoltaic street lighting system comprises a compact fluorescent lamp, lead acid battery, PV module(s), control electronics, inter-connecting wires/cables, module mounting hardware, battery box, instruction and maintenance manual.

- TECHNICAL SPECIFICATIONS & GENERAL SPECIFICATIONS:**

#### **1) DUTY CYCLE:**

The system will be designed to automatically switch ON at dusk, operate throughout the night and automatically switch OFF at the down, under average daily insulation of 5 KWh/sq. m. on a horizontal surface

#### **2) LAMP:**

- (a) The lamps will be of compact fluorescent (CFL) type, either 4 . Pin or 2 . Pin types, with ratings of 11 W. For the 4 . Pin type CFL, a suitable pre-heating circuit must be provided.
- (b) The light output from the lamp will be around 850 to 900 + 5% lumens. Also, please see (c) of 4 given below.
- (c) The lamps will be housed in a weatherproof assembly suitable for indoor use, with a reflector on its back. While fixing the assembly, the lamp will be held in a base up configuration.
- (d) Maximum DC current consumption for a 11W CFL at 12 V, will not exceed 1 Amp.
- (e) The lamps will conform to relevant BIS standards.

#### **3) BATTERY:**

- a) Flooded electrolyte type, positive tubular plate, low maintenance lead acid battery, conforming to relevant BIS standards or gel type VRLA.
- b) The battery will have a minimum rating of 12V, 75 Ah (at C/10) discharge rate.
- c) 75% of the rated capacity of the battery will be between fully charged and load cut off conditions.

#### **4) ELECTRONICS:**

- a) The inverter will be of quasi sine wave/sine wave type with frequency in the rage of 20-35 KHz. Half - wave operation is not acceptable.
- b) The total electronics efficiency will be at least 80%.

- c) No blackening or reduction in the lumen output by more than 10% will be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle).
- d) The idle current consumption will not be more than 10 mA.
- e) Electronics will operate at 12 V and will have temperature compensation for proper charging of the battery throughout the year.
- f) Necessary lengths of wires/cables and fuses will be provided.
- g) The PV module will be used to sense the ambient light level for switching ON and OFF the lamp.

**5) PV MODULE (S):**

- a) The PV module (s) shall contain mono/ multi crystalline silicon solar cells. It is preferable to have certificate for the supplied PV module as per IEC 61215(revised) specifications or equivalent National or International Standards. In case if the supplied PV module is not a regular PV module of the manufacturer and does not have certificate as per IEC 61215(revised) specifications ,then the manufacturer should have the required certification for at least one of their regular modules. Further, the manufacturer should certify that the supplied module is also manufactured using same material design and process similar to that of certified PV module.
- b) Power output of the module (s) under STC will be a minimum of 74W. Either two modules of minimum 37 W output each or one module of 74 W output will be used.
- c) The operating voltage corresponding to the power output mentioned above will be 16.4 V.
- d) The open circuit voltage of the PV modules under STC will be at least 21.0 volts.
- e) The terminal box on the module will have a provision for replacing the cables, if required.
- f) A strip containing the following details will be laminated inside the module so as to be clearly visible from the front side:
  - Name of the Manufacturer or distinctive logo.
  - Model or Type No.
  - Serial No.
  - Year of make

**6) ELECTRONIC PROTECTION:**

- a) Adequate protection is to be incorporated under no load conditions, e.g., when the lamp is removed and the system is switched ON.
- b) The system will have protection against battery overcharge and deep discharge conditions.

- c) Fuses will be provided to protect against short circuit conditions.
- d) A blocking diode preferably a Schottky type, will be provided as part of the electronics to prevent reverse flow of current through the PV module (s), in case such diode is not provided with the PV module (s).
- e) Full protection against open circuit, accidental short circuit and reverse polarity will be provided.
- f) Electronics should operate at 12 V and **should have temperature** compensation for proper charging of the battery through out the year.

## **7) MECHNICAL COMPONENTS:**

- a) Metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure will have provision to adjust its angle of inclination to the horizontal between 0° and 45°, so that the module (s) can be oriented at the specified tilt angle.
- b) The pole will be made of mild steel pipe with a height of 4 mtrs. above the ground level after grouting and final installation. The pole will have the provision to hold the weatherproof lamp housing. It will be painted with a corrosion resistant paint. The pole along with base plate shall have suitable cement concrete foundation to assisted local worst climate condition. The base plate shall be connected with the foundation with holding down bolted.
- c) A vented, acid proof and corrosion resistance painted metallic box/ Polyethylene for outdoor use will be provided for housing the battery.

## **8) OTHER FEATURES:**

- i) The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
  - (ii) There will be a Name Plate on the system, which will give:
    - (a) Name of the Manufacturer or Distinctive Logo.
    - (b) Serial Number.
  - (iii) Components and parts used in the solar street lighting systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.
  - (iv) The PV module(s) will be warranted for a minimum period of 15 years from the date of supply and the street lighting system (including the battery) will be warranted for a period of two years from the date of supply. The Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.
- (V) Necessary lengths of wires/cables and fuses should be provided

- 9) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar street lighting system.

The following minimum details must be provided in the Manual:

- (a) About Photovoltaics
- (b) About solar street lighting system - its components and expected performance
- (c) About PV module.
- (d) About CFL.
- (e) About battery.
- (f) Clear instructions about erection of pole and mounting of PV module and lamp housing assembly on the pole.
- (g) About electronics.
- (h) About charging and significance of indicators.

**10) General Installation Specifications: -**

- 10.1 The SPV module will be fixed on a rigid pole. The pole will of minimum 5 cm dia GI / MS pipe of medium gage with corrosion resistance paint.
- 10.2 Adequate space will be provided behind the PV module / array for allowing unobstructed airflow for passive cooling.
- 10.3 Cables of appropriate size will be utilized to keep electrical losses to a bare minimum.
- 10.4 The battery will locate in a dry area with proper ventilation. Care will be taken to ensure that the battery is placed with appropriate leveling on a structurally sound surface.
- 10.5 The control electronics will not be installed directly above the battery. All wiring will be in proper conduit or capping casing. Wire will not be hanging loose.
- 10.6 Any minor items which are not specifically included in the scope of supply but required for proper installation and efficient operation of the SPV systems is to be provided by the manufacturers / suppliers.

## **D) WHITE LED BASED SOLAR HOME LIGHTING SYSTEMS:**

- DEFINITION**

Light Emitting Diode (LED) is a p-n junction device which emits light when forward electric current passes through it. A LED based solar home lighting system aims at providing solar electricity for operating LED lights and / or other small DC loads for specified hours of operation per day.

The broad performance specifications of a Light Emitting Diode (LED) light source based solar home lighting system are given below.

- BROAD PERFORMANCE PARAMETERS**

Light Source	White Light Emitting Diode (W-LED)
Light Out put	White colour (colour temperature 5500 $^{\circ}$ -6500 $^{\circ}$ K) minimum 15 LUX when measured at the periphery of 2.5 meter diameter from a height of 2.5 meter. The illumination should be uniform without dark bands or abrupt variations, soothing to the eye. Higher light output will be preferred.
Mounting of light	Wall or ceiling
Electronics	Min 85% efficiency
Average duty cycle	5 hours a day
Autonomy	3 days (Minimum 12 operating hours per permissible discharge)

**There will be two models of LED home lighting systems. The Model-I will have one W-LED light source and the Model-II will have two W-LED light sources. Each light source should provide light out put as mentioned above. The requirement of PV module and battery will be as per the following details.**

### **Model I**

PV Module        8 Wp under STC, measured at 16.4 V as V load. Module Voc minimum of 21 V  
Battery           Sealed maintenance free, 12 V- 7 AH @ C/20, Max DoD 75%

### **Model II**

PV Module        12 Wp under STC, measured at 16.4 V as V load. Module Voc minimum of 21 V  
Battery           Lead acid flooded or Gel type VRLA, 12 V- 20 AH @ C/10, Max DoD 75%

- Other Details**

#### **1) DUTY CYCLE**

The LED solar home lighting system should be designed to operate for average 5 hours a day, under average daily insolation of 5.5 KWh /sq.m. on a horizontal surface.

## **2) LIGHT SOURCE**

- (i) The light source will be of white LED type. Single lamp or multiple lamps can be used. View angles of a minimum of 120° or above. **The luminous performance of individual LED used should not be less than 90 lumen / watt, when measured luminaire as a whole.** The colour temperature of white LEDs used in the system should be in the range of 5500° K . 6500° K. Use of LEDs which emit ultraviolet light will not be permitted.
- (ii) The light output from the white LED light source should be constant through out the duty cycle.
- (iii) The lamps should be housed in an assembly suitable for indoor use with an appropriate heat sink to dissipate heat generated during operation. The temperature of LED should not increase more than 10o above room temperature. This condition should be compiled even after two hours of operation at its maximum operation voltage (i.e. Just before over voltage cut off).
- (iv) The make, model number, country of origin and technical characteristics of white LEDs used in the lighting system must be furnished to the test centers. In absence of this data the solar home lighting system will not be accepted by the test centers for testing.

## **3) BATTERY**

- (i) **Battery should conform to latest BIS standards. A copy of the test certificate for the battery (including its make, and model number) used in the system should be provided to the test center.**
- (ii) At least 75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.

## **4) ELECTRONICS**

- i. **The total electronic efficiency of DC-DC converter should be at least 85%.**
- ii. Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery through out the year.
- iii. The light output should remain constant with variations in the battery voltages.
- iv. Necessary lengths of wires / cables, switches suitable for DC use and fuses should be provided.
- v. Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery through out the year

## **5) PV MODULE**

- (a) **The PV module (s) shall contain mono/ multi crystalline silicon solar cells. It is preferable to have certificate for the supplied PV module as per IEC 61215 (revised) specifications or equivalent National or International Standards. In case if the supplied PV module is not a regular PV module of the manufacturer and does not have certificate as per IEC 61215**

(revised) specifications, then the manufacturer should have the required certification for at least one of their regular modules. Further, the manufacturer should certify that the supplied module is also manufactured using same material design and process similar to that of certified PV module

- (b) The power output of the PV module must be reported under standard test conditions (STC) at 16.4 Volt loading voltage. I\_V curve of the sample module should be submitted to the test center at the time of system qualification testing.
- (c) The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- (d) The terminal box on the module should have a provision for opening for replacing the cable, if required.
- (e) A strip containing the following details **should be laminated** inside the module so as to be clearly visible from the front side:
  - i. Name of the Manufacturer or distinctive Logo
  - ii. Model or Type No.
  - iii. Serial No.
  - iv. Year of make.

## 6) ELECTRONIC PROTECTIONS

- 1. The system should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.
- 2. Fuses should be provided to protect against short circuit conditions.
- 3. A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module(s), in case such a diode is not provided with the PV module. Full protection against open circuit, accidental short circuit and reverse polarity should be provided.
- 4. Electronics should operate at 12 V and **should have temperature** compensation for proper charging of the battery through out the year.

## 7) MECHANICAL COMPONENTS

- (i) Metallic frame structure (with corrosion resistance paint) to be fixed on the roof of the house to hold the SPV module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle.
- (ii) It should be possible to mount the light source on a wall or ceiling or hang it from the ceiling in a stable manner.
- (iii) A vented plastic/ wooden/ metallic box/ Polyethylene with acid proof corrosion resistance paint for housing the storage battery indoors should be provided.

## **8) OTHER FEATURES**

- (i) The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
- (ii) There will be a Name Plate on the system body which will give:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number
  - (c) Serial Number
  - (d) Year of manufacture

## **9) QUALITY AND WARRANTY**

- i. Components and parts used in White LED based solar home lighting systems should conform to the latest BIS / international specifications, wherever such specifications are available and applicable. A copy of the test report / certificate stating conformity of BIS / international standards must be submitted to the test centre.
- ii. **The PV module will be warranted for a minimum period of 15 years from the date of supply and the White LED solar home system (excluding the battery) will be warranted for a period of at least 5 years from the date of supply. The sealed maintenance free battery should be warranted for a period of at least two year. The lead acid flooded type battery or gel type VRLA battery should be warranted for a period of 5 years.**
- iii. The manufacturers of white LED based solar home lighting system are required to provide to the test center a detailed report on the tests performance by them and the actually measured values of PV module, electronics, LEDs and battery and other related parameters, as per MNRE specifications. Mere mention of compliance to MNRE specifications is not acceptable and such samples may not be tested by the Test center. The test center will refer to the measured values provided by the manufacturer in the test report issued by the test center.

## **10) DOCUMENTATION**

- i. An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar home system. The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About White LED solar home lighting system - its components and expected performance
  - (c) About PV module. In case of imported modules it is mandatory to provide a copy of the international product qualification certificate to the test centre.
  - (d) About White LED Lights. The make, model number, country of origin and technical characteristics of LEDs should be stated in the product data sheet and furnished to the test centers.

- (e) About battery
- (f) Clear instructions about mounting of PV module
- (g) About electronics
- (h) About charging and significance of indicators
- (i) DO's and DONT's
- (j) Clear instructions on regular maintenance and trouble shooting of solar home system.
- (k) Name and address of the person or service center to be contacted in case of failure or complaint.

## **E) WHITE LED BASED SOLAR STREET LIGHTING SYSTEMS:**

- DEFINITION**

Light Emitting Diode (LED) is a p-n junction device which emits light when forward electric current passes through it. A LED based solar street lighting system aims at providing solar electricity for operating LED lights for specified hours of operation per day. The broad performance specifications of a White Light Emitting Diode (W-LED) light source based solar street lighting system are given below:

- BROAD PERFORMANCE PARAMETERS**

Light Source	White Light Emitting Diode (W-LED)
Light Out put	White colour (colour temperature 5500 <sup>0</sup> -6500 <sup>0</sup> K) minimum 15 LUX when measured at the periphery of 4 meter diameter from a height of 4 meter. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred.
Mounting of light	Minimum 4 meter pole Mounted
PV Module	45 Wp under STC, measured at 16.4 Vat load. Module Voc minimum of 21V
Battery	Tabular Lead acid or gel type VRLA, 12 V- 40 AH @ C/10, Max DoD 75%
Electronics	Min 85% total efficiency
Average duty cycle	Dusk to dawn
Autonomy	3 days (Minimum 42 operating hours per permissible discharge)

- Other Details**

### **1) DUTY CYCLE**

The LED solar street lighting system should be designed to operate for dusk to dawn, under average daily insolation of 5.5 KWh /sq.m. on a horizontal surface.

### **2) LIGHT SOURCE**

The light source will be of white LED type. Single lamp or multiple lamps can be used. Wider view angles of a minimum of 120<sup>0</sup> or more.

- 1. The luminous performance of individual LED used should not be less than 90 lumen/watt when measured luminaire as whole.** The colour temperature of white LEDs (ii used in the system should be in the range of 5500<sup>0</sup> K . 6500<sup>0</sup> K. Use of LEDs which emits ultraviolet light will not be permitted.
2. The light output from the white LED light source should be constant through out the duty cycle.

3. The lamps should be housed in an assembly suitable for outdoor use. **The temperature of LED should increase not more than 15° above ambient temperature. This condition should be compiled even after two hours of operation at its maximum operation voltage (i.e. Just before over voltage cut off)**
4. The make, model number, country of origin and technical characteristics of white LEDs used in the lighting system must be furnished to the test centers and to the buyers. In absence of this data the solar lantern will not be tested by the test center.

### **3) BATTERY**

- (i) **Tubular Lead acid or gel type VRLA battery should conform to latest BIS standards. A copy of the test certificate for the battery (including its make, country of origin and model number) used in the system should be provided to the test center.**
- (ii) At least 75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.

### **4) ELECTRONICS**

- (i) **The total electronic efficiency of DC-Dc converter should be at least 85%.**
- (ii) Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery through out the year.
- (iii) The light output should remain constant with variations in the battery voltages.

### **5) PV MODULE**

- (a) **The PV module (s) shall contain mono/ multi crystalline silicon solar cells with IEC 61215(revised) certification or equivalent National or International Standards. The manufacturer should have the required certification for at least one of their regular modules. Further, the manufacturer should certify that the submitted module is also manufactured using same design and process.**
- (b) The power out put of the PV module must be reported under standard test conditions (STC) at 16.4 Volt loading voltage.  $I_V$  curve of the sample module should be submitted to the test center at the time of system qualification testing.
- (c) The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- (d) The terminal box on the module should have a provision for opening for replacing the cable, if required.
- (e) A strip containing the following details should be laminated inside the module so as to be clearly visible from the front side:
  - a) Name of the Manufacturer or distinctive Logo
  - b) Model or Type No.
  - c) Serial No.
- d) Year of make

## **6) ELECTRONIC PROTECTIONS**

1. The system should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.
2. Fuses should be provided to protect against short circuit conditions.
3. A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module(s), in case such a diode is not provided with the PV module.
4. Full protection against open circuit, accidental short circuit and reverse polarity should be provided.
5. Electronics should operate at 12 V and **should have temperature** compensation for proper charging of the battery through out the year.

## **7) MECHANICAL COMPONENTS**

- (i) Metallic frame structure (with corrosion resistance paint) to be fixed on the roof of the house to hold the SPV module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle.
- (ii) It should be possible to mount the light source on a metallic arm attached to the pole. The metallic arm for holding the light assembly should be extended at least 1.5 metres from the pole and set at a suitable angle to maximize uniform illumination of desired level over the specified area.
- (iii) A vented metallic / plastic box/ Polyethylene with acid proof corrosion resistance paint for housing the storage battery outdoors should be provided.

## **8) OTHER FEATURES**

- (i) The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
- (ii) There will be a Name Plate on the system body, which will give:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number
  - (c) Serial Number
  - (d) Year of manufacture
- (iii) Necessary lengths of wires / cables, switches suitable for DC use and fuses should be provided.

## **9) QUALITY AND WARRANTY**

- (i) Components and parts used in White LED solar street lighting systems should conform to the latest BIS / international specifications, wherever such specifications are available and applicable. A copy of the test report / certificate stating conformity of BIS / international standards must be submitted to the test centre.

- (ii) The PV module will be warranted for a minimum period of 15 years from the date of supply and the complete White LED solar street lighting system including the battery) will be warranted for a period of at least 5 years from the date of supply.
- (iii) The original manufacturers of white LED based solar home lighting system are required to provide to the test center a detailed report on the tests performance by them and the actually measured values of PV module, electronics, LEDs and battery and other related parameters, as per MNRE specifications. Mere mention of compliance to MNRE specifications is not acceptable and such samples may not be tested by the Test center. The test center will refer to the measured values provided by the manufacturer in the test report issued by the test center.

## **10 DOCUMENTATION**

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar street lighting system.

The following minimum details must be provided in the Manual:

- (a) About Photovoltaic
- (b) About White LED solar street lighting system - its components and expected performance.
- (c) About PV module. In case of imported modules it is mandatory to provide a copy of the international product qualification certificate to the test centre.
- (d) About White LED Lights. The make, model number, country of origin and technical characteristics of LEDs should be stated in the product data sheet and furnished to the test centres
- (e) About battery and electronics used
- (f) Clear instructions about mounting of PV module.
- (g) About charging and significance of indicators.
- (h) DO's and DONT's,
- (i) Clear instructions on regular maintenance and trouble shooting of solar street lighting system.
- (j) Name and address of the person or service center to be contacted in case of failure or complaint.

## **2) TECHNICAL SPECIFICATION OF SOLAR WATER HEATING SYSTEM**

### **2-A) Natural Thermosyphon and Pressurized system**

Capacity & Temperature: 125 LPD to 3000 LPD and 60°C.

Sr. No.	Item and Specifications	Natural Thermosyphon	Pressurized @ 3.5 Kg/Cm <sup>2</sup> Thermosiphon
1	Supply of collectors and stand with installation Absorber: cu-cu only. Box Aluminum (ISI Mark Only) IS 12933	As per system capacity	As per system capacity
2	Supply & installation of insulated storage tank with stand	Capacity same As per system capacity	Capacity same As per system capacity
	Material of construction	Stainless steel -304 / C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides	Stainless steel -304 / C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides
	Insulation with thickness of material	Rock wool 100 mm/ PUF 50 mm upto 2000 LPD system	Rockwool 100 mm/ PUF 50 mm upto 2000 LPD system
	Density of insulation	RocKWool - 48 kg / m <sup>3</sup>	RocKWool - 48 kg / m <sup>3</sup>
		PUF - 40 kg / m <sup>3</sup>	PUF - 40 kg / m <sup>3</sup>
	Insulation cover	Aluminum sheet 22 swg /GI pre coated sheets	Aluminum sheet 22 swg/GI pre coated sheets
3	Supply control instruments with installation	1 set for each system	1 set for each system
	• Tap (Brass Tap)	1 No.	1 No.
	• Gate Valve (Brass, 1inch, ISI Mark)	2 Nos.	2 Nos.
	• Non return valve (ISI Mark)	1 No	1 No
	• Air release valve (ISI Mark)	1 No	1 No
	• Strainer (ISI Mark)	1 No	1 No
	• Pressure Release Valve	NA	1 No
	• Pressure Gauge	NA	1 No
	• Temperature Gauge (4+ dial, H Guru make)	1 No (1500 lpd to 3000 lpd)	1 No (1500 lpd to 3000 lpd)
4	Capacity of cold water tank	As per requirement (Minimum capacity of cold water tank shall be equivalent to the capacity of the system e.g. For 125 LPD system Cold Water Tank should be of 125 liter)	As per requirement (Minimum capacity of cold water tank shall be equivalent to the capacity of the system e.g. For 125 LPD system Cold Water Tank should be of 125 liter)
5	Supply of piping G I, Class B, ISI	6 mtr for each system	6 mtr. for each system
	Cold Water - 1 "		
	User piping upto one use point.	30 mtr for each system	30 mtr for each system
	Dia 20 mm (insulated) (Kitec or equivalent slandered make.)		

## **01. ABSORBER**

- (A) Material** : Absorber shall be of Cu-Cu type only  
(Copper Sheet and Copper Tube)
- (a) Thickness of Sheet** : 34 SWG (0.19 mm) minimum
- (b) Risers** : Diameter: 12.7 mm (+ 0.5 mm)  
Thickness: 24 SWG (0.56 mm)  
(+ No limit, - 0.07 mm)
- (c) Header** : Diameter: Minimum 25.4 mm (OD) + 0.5 mm  
Thickness: 0.71 mm (+ no limit -0.07 mm)  
Projection: 40 mm (+ 5mm) out side  
  
(Including the collector box flange thickness)
- \* Number of fins and tubes: Nine / collector
- (d) Space between Riser Tubes :**
- Maximum space between riser tubes shall be 12 cm from centre to centre of the risers. The free edges at the sides should not exceed 6 cm from the centre of the extreme and riser tube. For independent fins or joints in the sheet an overlap of minimum 2 mm shall be provided.
- (e) Bonding between Riser and sheet:**
- Welding may be of continuous nature inert arc spot welding type with the product of number of spots per fin and area of spots exceeding the product of length of the fin and twice the thickness of the fin for each fin. (Continuous welding)
- (B) Area of Absorber** : 2.0 Sq. M (+0.1 m<sup>2</sup>) including the projected area of the header.
- (C) Header - Riser Joints :**
- The assembly of risers with the header shall ensure not more than 5 mm tube extension inside the header. The riser shall be brazed to the header with suitable brazing alloys with or without the use of flux.
- Any flux used in soldering/ brazing shall be mechanically removed and neutralized with the solution of sodium carbonate to avoid corrosion problem in future.
- (D) Absorber Coating :**
- Selectively coated with solar absorptive more than 0.92 and infrared emissive less than 0.20 shall be used. The coating should be stable up to 300 °C.

## **02 FLAT PLATE COLLECTORS:**

- (a) **Overall Dimensions of the Collector Box** : a) Length = 186 cm (+1cm) / 212 cm (+ 1 cm) / 205 cm (+ 1 cm)  
b) Breadth = 124 cm (+1cm)/104cm (+ 1 cm) / 93 cm (+ 1 cm)  
c) Height = 10 cm (+1 cm) / 10 cm (+ 1 cm) / 9.3 cm (+ 1 cm)
- (b) **Collector Box Materials** : Excluding glass and glass retainer
- (i) **Aluminum:**  
Aluminum extruded sections of size approximately 100 mm x 25 mm channel sections and of thickness 1.6 + 0.2 mm  
Aluminum sheet for the bottom shall be of thickness 0.71 + 0.07 mm  
Aluminum Sheet for entire body shall be of 1.0 mm thickness (minimum) 1.2 mm thick Aluminum angle (dimensions 25 mm x 25 mm) as a retainer for glass.
- (ii) **Fabrication of the Box:**  
Side Channels shall be welded by inert arc gas welding or gas brazing to ensure leak proof continuity of the joints of the box.
- (iii) **Attachment of Bottom sheet:**  
Bottom sheet shall be attached by riveting, spot welding or with S.S. screws and caulking of the joints with sealing paste of Zinc Oxide based or rubber based or silicon rubber based epoxy based sealing compounds. Caulking may be done on the inside joints or inside as well as outside joints or inside as well as outside joints to ensure leak proof joints.
- (iv) **The complete aluminum box should be powder coated or anodized.**

## **03 Testing of Riser - Header Assembly:**

It will be tested for leakage and strength at a minimum hydraulic / pneumatic pressure of 5 kg/cm<sup>2</sup> for all thermos phonic systems and systems designed for operation at 2.5 kg / cm<sup>2</sup> or below. For systems designed for operation at higher pressure, test pressure shall be twice the system design pressure.

## **04 COLLECTOR BOX INSULATION:**

### **(a) Back Insulation:**

Insulation of R value =  $1.67 \text{ m}^2 \text{ C /W}$  to withstand a temperature of  $250^\circ \text{C}$  should be used.

**Typical insulations are:**

Sr. No.	Trade Name	K	(kg/m <sup>3</sup> )	R	Minimum thickness
1.	Spintex 300 (Rock wool)	0.029	48	1.67	50 mm
2.	Twig Glass wool	0.033	48	1.67	65 mm

Aluminum foil of thickness 0.016 mm + 0.005 mm shall be used for covering the back insulation.

### **(b) Side Insulation:**

Resin bonded white glass wool/Rigid polyurethane/ industrial grade spintex shall be used. So as to achieve R value =  $1.67 \text{ m}^2 \text{ C/W}$ . Typical insulation is as given in 4 (a).

The side insulation shall be 15 mm thick (minimum). Aluminum foil of thickness 0.016 mm to 0.015 mm shall be used for covering the side insulation.

## **05 FRONT GLAZING:**

4 mm thick + 0.2 mm toughened / tempered (Hardened) glass having transitivity of 85% or more shall be used. In hilly region only toughened glass of 4mm / 5mm of transitivity 82% or more should be used.

## **06 HEADER FLANGES:**

- Brass flanges of 62 mm + 3 mm diameter and minimum thickness of 4 mm with provision for four numbers of SS / GI or cadmium plated bolts with diameter of 5 mm - 6 mm shall be used. Flanges shall be brazed to the header and brazing tested for leakage at the test pressure. In no case crude soldered flanges shall be used. The assembly of the flanges should be at right angle to the header area to ensure proper assembly at the site of installation.

## **07 GROMMET:**

Suitable sealing between the inlet and outlet of header and casing of the following materials shall be provided,

Neoprene, EPDM, Silicon Rubber and Butyl Rubber.

The grommet shall be suitable for a temperature upto  $150^\circ \text{C}$  and mechanical loading during transportation of collectors. Typical size of grommet may be 40 mm outer dia. and 25 mm inner dia.

**08 ASSEMBLIES OF COLLECTORS:**

The load of the absorber should not be on the insulation. It should be taken by the collector box.

The air gap between the glazing and the absorber should be 30 mm (+5 mm).

Insulation should not be allowed to slide one of the ways is to provide extra glass wool pad below the header to clamp the back insulation pad between the header and the collector box. Glazing shall be fixed on the collector box by using EPDM channels /sponge rubber strips both at the top and bottom of the glass.

The glass should be firmly held, without strain, taking into account the expansion of glass. A typical while fixing the screws on the top of the box example is by retaining the glazing with the help of stainless steel screws and aluminum angle retainer of dimensions 25 mm x 25 mm x 1.6 mm fixed on the top of the box it shall be ensured that the screws are not touching the glass edge.

Top surface along the edge between the glass and the aluminum angle shall be sealed with suitable sealants such as zinc oxide based / rubber based / silicon rubber based and polysulphide rubber sealants.

**09 GASKET FOR FLANGES:**

3 mm thick compressed asbestos fiber gasket or Neoprene rubber or EPDM gasket shall be used for sealing the joints between flanges.

**10 COLLECTOR SUPPORT FRAME:**

The structure should be in a position to withstand a wind velocity of 100 Kms /Hr. A typical way to do this is that it shall be made with angle iron stronger than 35 mm x 35 mm x 3 mm and shall have vertical support at top and bottom edge of the inclined plane of the collector at a distance of 2.5 m or less. The vertical support shall be firmly grouted to the roof in the ground in case of ground mounted system. The grouting blocks shall be of minimum equal to 25 cm x 25 cm x 15 cm and finished properly. In case the grouting is carried out on a roof already water proofed with asphalt the back support of the collectors may be anchored to the parapet or the size of the grouting block shall be increased to provide for a dead weight anchoring of 75Kg per leg of the vertical support. Other alternative may be got approved from Director General, MEDA, Pune.

**11 PAINTING OF STANDS:**

Proper cleaning and degreasing of the surface should be done before painting. Two coats of zinc chromatic red oxide primer shall be applied followed by one coat of enamel paint of suitable color. For coastal areas and areas of sulphuric fumes and chlorides suitable anti-corrosion paints like polyurethane paint or epoxy paint should be applied after proper treatment in shop.

The manufacturer may use Zinc plated stand as it has longer life.

## **12 STORAGE TANK**

### **(A) Material: De-Pressurized**

The tank shall be made up of stainless steel or C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides.

The storage tank for 125/ 250 liters capacity shall be made of 22 SWG stainless steel only. Copper tank of thickness 20 SWG may also be used. However, proper precautions shall be taken in case of higher heads.

Between 250 to 500 liters capacity the storage tank shall be of stainless steel of thickness 20 SWG, for 500-1500 liters, it shall be of 16 SWG, for 1500- 3000 liters, it shall be of 14 SWG and for capacity more than 3000 liters it shall be of 10 SWG thickness or more with proper stiffening.

Support structure shall be designed properly to withstand the load of the Storage Tank, wind speed and the stored water.

#### **Material: Pressurized@3.5 kg/cm<sup>2</sup>**

The tank shall be made up of stainless steel or C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides.

The storage tank for 125/ 250 liters capacity shall be made of 16 SWG stainless steel only.

Between 250 to 500 liters capacity the storage tank shall be of stainless steel of thickness 14 SWG, for 500-1500 liters, it shall be of 12 SWG, for 1500-3000 liters, it shall be of 10 SWG and for capacity more than 3000 liters it shall be with proper stiffening & with standing strength.

Support structure shall be designed properly to withstand the load of the Storage Tank, wind speed and the stored water.

### **(B) Insulation:**

Insulation of R value =  $3.34 \text{ m}^2 \text{ }^\circ\text{C/W}$ . to withstanding a temperature of  $100 \text{ }^\circ\text{C}$ . Should be used. Typical insulations are: -

Sr. No	Trade Name	K (W/ mk)	Density (kg/m <sup>3</sup> )	R	Minimum Thickness
1.	RockWool	0.029	48	3.34	100 mm

RockWool insulation with the same density will be permitted for the use. Thin polythene sheet shall be used as covering between the rockWool and the cladding sheet besides the retaining material such as chicken mesh etc.

## **13 PIPING:**

### **(A) Material:**

Medium class (B class) GI as per IS 1239 shall be used for piping. Brand for piping to be used must be of ISI mark only.

**(B) Insulation:**

Insulation of  $R = 1.67 \text{ m}^2 \text{ Deg. C/W}$  to withstand a temp. of  $100^\circ \text{ C.}$  shall be used.  
Typical insulation is as given below,

Sr. No	Trade Name	K (W/ mk)	Density (kg/m <sup>3</sup> )	R	Minimum Thickness
1.	RockWool	0.029	48	1.67	50 mm

The Manufacturer can also use PUF insulation of 25 mm for all water heating system pipeline and for hot water tank Puff insulation is of 50 mm.

Thin plastic sheet shall be used as covering between RockWool and aluminum cladding besides other retaining material 26 SWG aluminum sheet shall be used for cladding the insulated pipe.

**14 VALVES / NIPPLES / TEES / BENDS:**

Gunmetal valve as per ISI specification shall be used.

Nipple/Tees and bends shall be of medium class GI (B class).

Gunmetal valve in each row shall be provided. Air vents in each row are to be provided. Valve should be of chrome plated  $90^\circ$  rotation ball valve should be used having standard brand.

- 15 Those items, which are exposed to the air and likely to be corroded, therefore should be treated with anti corrosive treatment i.e. application of epoxy painting.**
16. The system shall be supplied and installed with ISI mark, Cu-Cu selectively black chrome coated only or Cr-Al selective coating of International standard and with BIS approval.
  17. All the joints should be flanged-type / union type with proper temperature gaskets. Rubber joints will not be accepted. Bolts and nuts used in the joints should be adequately protected against corrosion.
  18. All pipe lines used should be ISI marked for the hot as well as cold water should be galvanized iron class - B conforming to IS No. 1239.
  19. Instrumentation control valves and other accessories should be of high quality and of ISI make with high reliability.
  20. All metal parts which are likely to get corroded should be protected by suitable paints.
  21. The whole assembly shall be tested hydrolytically to withstand a pressure of 5 kg / sq. cm.
  22. All installations including collectors and pipelines are to be supported on suitable permanent metal structural supports designed for the purpose and grouted / bolted properly.
  23. Civil Engineering work or construction work of any kind shall be carried out by the Contractor.

24. Angle of response for collector should be latitude plus 15<sup>0</sup>, facing south with no shadow on neighboring collector rows.
25. All pipe lines carrying hot water above ambient temperature should be insulated with fiber rock wool / mineral wool 50 mm thick with thermal conductivity less than 0.04 K cal/hr-m degree C. or polyurethane of equivalent thickness. Hot water tank should be insulated with 100 mm thick rock wool / mineral wool.
26. The system should be painted with anticorrosive paint. One coat of primer and two final coats should be applied.

**27. Scope of work:**

- a. Design of the system.
- b. Fabrication, supply and installation of suitable flat plate collectors.
- c. Design, fabrication, supply and the installation of suitable support for the collectors, pipes, valves and other components and accessories.
- d. Design, supply, fabrication, installation of cold water tank and insulated storage tank, cold water piping, insulated user piping.
- e. Supply and installation of control instrumentation required for the system.
- f. Civil work (grouting) of collectors, collector stands and tank.
- g. Hydraulic testing and commissioning of the system.
- h. Any additional works not covered above.
- i. Supply of manual for Operation and Maintenance to the Maintenance department of concerned beneficiary institute.
- k. Commissioning of the entire system.
- l. Training to the user for operation and maintenance of the system.

**2 - B) Solar Water Heating System (Forced flow circulation Type):** (Capacity 3000 to 5000 lpd)

**Forced Circulation system** - The systems between 3000 lpd to 5000 lpd shall operate on forced circulation pattern. The system should operate on differential temp. controller logic. The following should take into consideration while designing the same:

**For: Pump Control Panel with DTC**

Description	Specification / Make
OLR & MCB	L&T / Siemens
Sensors	RTD PT-100 with SS-304, 12+stem
Motor Selector Switch	L&T / KEC

**For: Intercirculation Pumps**

Make	Grundfoss / Kirloskar / reputed make
Type	1 Hp
Purpose	Internal Circulation
Quantity	1 + 1 standby

**3) TECHNICAL SPECIFICATION OF WIND SOLAR HYBRID SYSTEM 1 KW**

**3 - A) Technical Specifications of 1 KW Wind Solar Hybrid System**

Sr. No.	Components and Specifications	Quantity
1	Capacity	600W
	Make	Southwest Wind power, Arizona, USA/ Any other approved and tested
	Model	Air x 600 watt
	Rated wind speed (m/s / kmph)	10/25
	Peak Power	600 Watts at 12.5 m/s
	Survival wind speed	55 m/s
	R.P.M. (Max.)	500
	Start Generating Wind Speed	3.1 (m/s)
	Rotor Diameter	46+
	Propeller Material & No. of Blades	Injection molded carbon reinforced-2 Nos.
	Generator	Permanent Magnet Type
	Weight	6 Kgs.
	Voltage Controller	Auto charge regulator
	Over speed protection	Manual and automatic braking
	No. of machines	1 No.
2	<b>Tower</b>	
	Type	Piped with supporting guy wires
	Material of construction	M.S.
	Finish	Duly epoxy coated
	Tower height from ground	18 mtrs
3	<b>Battery Bank</b>	
	Type of batteries	Deep Cycle Tubular
	Capacity	12V/300 AH
	Make	HBL / Exide/ Equivalent
4	<b>Inverter</b>	
	Capacity	12 V / 0.5 kVA
	Type	Sine Wave
	Input voltage	12 V
	Make	Sukam / Equivalent
	Efficiency	90% minimum
5	<b>SOLAR PV PANELS</b>	
	Capacity	400 watts
	Make	Any MNRE approved
	Peak Power per module	75 Watts. / 100 Watts

<b>Sr. No.</b>	<b>Components and Specifications</b>	<b>Quantity</b>
	Dimension W * H * D	For 75Wp module 965 * 635 * 36 mm For 100Wp module 1295*650*36mm
	Temperature	- 40 to +90 degree
	Wind Load	upto 200Kmph
	Humidity	0 to 100%
	No. of S.P.V. Modules	6 Nos. of 100Wp/Equivalent
	SPV Support structure	M.S. Angle
6	Power Centre for Aero generator consisting of Rectifier, Regulator charger, Solid State Passive Cooling constant voltage charging, fully automatic operation having display battery voltage and charging status and charge controller, Circuit Breakers, Manual break switch, non-critical load segregation.	
7	Cabling from SPV Modules to power centre including inter connection	ISI Standard of appropriate sizing.
8	Cabling from WEG top to Power Centre	ISI Standard of appropriate sizing
9	Support structure for Solar PV panels	M.S. with Anticorrosive, U.V. protective epoxy based cost.
10	Instrumentation for power measure	Energy Meter Amp. Meter. Volt Meter.
11	Instrumentation for wind & solar measurement	Anemometer
12	Transportation	
13	System Design, Erection and commissioning	
14	Civil Work	RCC Construction.

**3-B) Technical Specifications of 5kW (60 To 65% Wind + 35 To 40% Spv)  
Wind Solar Hybrid System**

S. N.	Components and Specifications	Quantity
1	<b>Wind Aero generator with charge controller</b>	1 Set
	System Model	Whisper 500/or any other approved & tested by C-WET Chennai
	Power output	3200 to 3300W
	Poles/50 HZ/RPM	16/375/500
	Cut in wind speed	3 m/s
	Survival Wind speed	60 m/s
	Shaft Rate	500 RPM
	Generator Control	Furling
a	Rotor blade	
	Nos of Blades	2
	Rotor Diameter	4.65 M
	Area (Sq meter)	16.99 sq meter
	Material	Carbon Fibre
	Maximum speed (m/s)	12.5 m/s
	Drive system	Direct
	Yaw system	360 degree
	Breaking mechanism	Electrical
	Power Transmission System	3 phase AC
3	<b>Tower</b>	
	Tower (self supported )	FOUR Legged self supported
	Material of construction	M.S. Angles
	Finish	Duly epoxy coated
	Tower height from ground	30 mtrs
4	<b>Battery Bank</b>	
	Type of batteries	Deep Cycle Tubular
	Current Capacity	750 AH/ 48V
	Voltage Configuration	48 VDC
	Rate of Discharge	80 %
	Make	Autobat/HBL/Exide/Sadan/Equivalent
	Sp. Gravity at 27 Deg Celsius	1.250
	Autonomy	2 days
5	<b>Inverter</b>	
	Capacity	5 kVA
	Type	Sine wave
	Input voltage	48 VDC
	Make	Luminous / Geneous / Equivalent
	Efficiency	92% minimum
	Diversity Factor	60%
	Power Factor	0.8%
6	Solar P.V. system with charge controller	1800 TO 2000 watts
	Capacity	1.8 to 2.0 KW
	Nos.	100 watts x18/20 nos. or equivalent
7	Power Centre for Aero generator consisting of Rectifier. Regulator charger,	

	Solid State Passive Cooling constant voltage charging, fully automatic operation having display battery voltage and charging status and charge controller, Circuit Breakers, Manual break switch, non-critical load segregation. Solar P.V. Panels shall be tested by any authorized testing of MNRE.	
8	Cabling from SPV Modules to power centre including inter connection	ISI Standard of appropriate sizing.
9	Cabling from WEG top to Power Centre	ISI Standard of appropriate sizing
10	Support structure for Solar PV panels	M.S. with Anticorrosive, U.V. protective epoxy based cost.
11	Instrumentation for power measure	Energy Meter Amp. Meter. Volt Meter.
12	Instrumentation for wind & solar measurement	Anemometer
13	Transportation	From your factory to the site
14	System Design, Erection and commissioning	System should be design as per the MNES Specification
15	Metering	Energy meter at consumption and at Generation side also
15	Civil Work	RCC Construction 1:3:6

**3-C) Technical Specifications of 10 KW (60 To 65% Wind + 35 To 40% Spv) Wind Solar Hybrid System**

S. N.	Components and Specifications	Quantity
1	Wind Aero generator with charge controller	2 Set
	System Model	Whisper 500/or any other approved & tested by C-WET Chennai
	Power output	3200 to 3300W
	Poles/50 HZ/RPM	16/375/500
	Cut in wind speed	3 m/s
	Survival Wind speed	60 m/s
	Shaft Rate	500 RPM
	Generator Control	Furling
a	Rotor blade	
	Nos of Blades	2
	Rotor Diameter	4.65 M
	Area (Sq meter)	16.99 sq meter
	Material	Carbon Fibre
	Maximum speed (m/s)	12.5 m/s
	Drive system	Direct
	Yaw system	360 degree
	Breaking mechanism	Electrical
	Power Transmission System	3 phase AC
3	<b>Tower</b>	
	Tower (self supported )	FOUR Legged self supported
	Material of construction	M.S. Angles
	Finish	Duly epoxy coated
	Tower height from ground	30 mtrs
4	<b>Battery Bank</b>	
	Type of batteries	Deep Cycle Tubular
	Current Capacity	1350 AH/ 48V
	Voltage Configuration	48 VDC
	Rate of Discharge	80 %
	Make	Autobat/HBL/Exide/Sadan/Equivalent
	Sp. Gravity at 27 Deg Celsius	1.250
	Autonomy	2 days
5	<b>Inverter</b>	
	Capacity	10 kVA
	Type	Sine wave
	Input voltage	48 VDC
	Make	Luminous/Geneous/Equivalent
	Efficiency	92% minimum
	Diversity Factor	60%
	Power Factor	0.8%
6	<b>Solar P.V. system with charge</b>	<b>35 to 40% SPV</b>

	<b>controller</b>	(3500 to 4000 watts)
	Capacity	3.5 to 4.0 KW
	Nos.	100 watts x35/40 nos. or equivalent
7	Power Centre for Aero generator consisting of Rectifier, Regulator charger, Solid State Passive Cooling constant voltage charging, fully automatic operation having display battery voltage and charging status and charge controller, Circuit Breakers, Manual break switch, non-critical load segregation. Solar P.V. Panels shall be tested by any authorized testing of MNRE.	
8	Cabling from SPV Modules to power centre including inter connection	ISI Standard of appropriate sizing.
9	Cabling from WEG top to Power Centre	ISI Standard of appropriate sizing
10	Support structure for Solar PV panels	M.S. with Anticorrosive, U.V. protective epoxy based cost.
11	Instrumentation for power measure	Energy Meter Amp. Meter. Volt Meter.
12	Instrumentation for wind & solar measurement	Anemometer
13	Transportation	From your factory to the site
14	System Design, Erection and commissioning	System should be design as per the MNES Specification
15	Metering	Energy meter at consumption and at Generation side also
15	Civil Work	RCC Construction 1:3:6

- 4) i) **SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS (DC Pumps)**  
(PV Module with a provision of single axis manual tracking only)
- A) **SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS FOR CAPACITY OF 1 H.P. (SPV Pump) (900 WATT PV Module)**

**I. DEFINITION**

A solar Photovoltaic water pumping system consist of a PMDC surface mounted motor, pump set, electronics if any, interconnect cables, MCB and a PV array mounted on a suitable structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the SPV water pumping system.

**II DUTY CYCLE**

The solar PV water pumping system should provide a minimum of 77 liters of water per watt of PV array used per day under average daily solar radiation conditions of 5.5 Kwh/sq.m. on a horizontal surface, from a total head of 10 meters (suction head up to a maximum of 7 meters). In case of deep well submersible pumps, the water requirement should be a minimum of 25 liters of water per watt of PV array capacity used per day from a total depth of 30 meters. Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is permitted. The manufacturer of SPV water pumping system is required to specify whether the minimum water out put is achieved directly or though tracking of PV array. The actual duration of pumping of water on a particular day and the quantity of water pumped may vary depending on the location, season etc.

**III PV ARRAY CAPACITY**

The SPV water-pumping system should be operated with a PV array in the range of P max = 900 watts, measured under standard test conditions.

Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. In case of thin film solar cell modules, the specified values of output power refer to the power output achieved after the initial degradation.

**IV MOTOR PUMP-SET**

Type of motor pump sets are permitted to be used in the SPV water pumping systems:

Surface mounted DC motor pump-set.

1. The wire to water efficiency of the surface motor pump set at 10 meter total head should be at least 40 %. They will also report the wire to water efficiency of the motor-pump set used by them & submit copy of the test report as proof to (MNRE) Solar Energy Centre.

## **V      PROTECTIONS:**

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

## **VI     OTHER FEATURES:**

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.  
The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About solar pump
  - (c) About PV module
  - (d) About motor pump set
  - (e) Clear instructions about mounting of PV module.
  - (f) About electronics used in AC motor pump sets, if any
  - (g) DO sand Donq,
- (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
- (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

**B) SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS FOR CAPACITY OF 2 H.P. (SPV Pump) (1800 WATT PV Module) for giving 10000 LPD vs. 90 m head @ 5.5 kWhr / Sq.m. / day solar irradiation incident in Maharashtra.**

**I) DEFINITION:**

A solar photovoltaic water pumping system consist of a PMDC / BLDC submersible / floating motor pump set, electronics if any, interconnect cables, a MCB / Controller and a PV array mounted on a suitable structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the SPV water pumping system.

**II) DUTY CYCLE:**

The solar PV water pumping system should provide a minimum of 77 liters of water per watt of PV array used per day under average daily solar radiation conditions of 5.5 KWh/sq.m. on a horizontal surface, from a total head of 10 meters (Suction head up to a maximum of 7 meters). In case of deep well submersible pumps, the water requirement should be a minimum of 25 liters of water per watt of PV array capacity used per day from a total depth of 30 meters. Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is permitted. The manufacturer of SPV water pumping system is required to specify whether the minimum water out put is achieved directly or though tracking of PV array. The actual duration of pumping of water on a particular day and the quantity of water pumped may vary depending on the location, season, etc.

**III) PV ARRAY CAPACITY:**

The SPV water-pumping system should be operated with a PV array of  $P_{max} = 1800$  watts, measured under standard test conditions.

Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. In case of thin film solar cell modules, the specified values of output power refer to the power output achieved after the initial degradation

**IV) MOTOR PUMP-SET:**

Following types of motor pump sets are permitted to be used in the SPV water pumping systems:

PMDC / BLDC Submersible motor pump set.

1. The wire to water efficiency of the submersible motor pump set should not be less than 50%. The manufacturer of the PV pumping system will submit a declaration that the PV array size has been selected for optimal matching with the motor-pump set to give the desired water out put performance. They will also report the wire to water efficiency of the motor-pump set used by them & submit copy of the test report as proof to (MNRE) Solar Energy Centre.

## **V) PROTECTIONS:**

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

## **V) OTHER FEATURES:**

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.  
The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About solar pump
  - (c) About PV module
  - (d) About motor pump set
  - (e) Clear instructions about mounting of PV module.
  - (f) About electronics used in AC motor pump sets, if any
  - (g) DO sand Don'ts,
- (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
- (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

**C) SPECIFICATIONS FOR 1 H.P Submersible pump for Bore well (900 W Pump)  
(675 WATT PV Module)**

**I) DEFINITION:**

A solar Hand pumping system consist of a submersible motor pump set, electronics if any, interconnect cables, a MCB / Controller and a PV array mounted on a suitable structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the Solar Hand pumping system.

**Technical Specifications:**

Maximum installation depth. 75 m.

Delivery head above ground (maximum). 6 m

Minimum Yield of hand pump @ 40 stroke/min. approximate 700 LPH

Daily yield at array of 5 . 6 kWh / m Sq. per day 5000 LPD

Wire to water efficiency > 50%

Maximum current input for solar drive 9.5 amps.

Maximum input power to submersible pump 675 Wp

Minimum required array for submersible pump to start 675 Wp

1 X special water chamber

1X solar power submersible pump

Solar panel 675 Wp

Every panel mounted in Aluminum frame and supported by galvanized angle frame and erected on galvanized pipe structure with single axis manual tracking arrangement.

**II) Submersible pump**

Light weight stainless steel pump and body

1 H.P., 900 W Submersible pump

Option for operating head from 15-90 m

Discharge range from 4500-6000 LPD

Rated speed 500-3600 rpm

Current 9.5 amps (maximum)

Cable 3 X 2.5 sq.mm

Suitable for 100 mm and above dia.

Bore wells Outlet size 32mm

The overall efficiency of the motor pump set at 10 meter total head should be at least 40% and the efficiency of the submersible motor pump set should not be less than 50%.

**IV) PV ARRAY CAPACITY:**

The SPV water-pumping system should be operated with a PV array of P max = 675 watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. The PV module shall contain mono / multi crystalline

silicon solar cells. The PV module shall be as per IEC 61215 (revised) specifications or equivalent National or international standards.

**V) MOUNTING STRUCTURES & TRACKING SYSTEM:**

To enhance the performance of Solar Hand pumps covered under the programme, it is desirable to use a tracking system. Manual, passive and electronic tracking are permitted. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 200 km per hour. The support structure used in the pumping system will be hot dip galvanized.

**VI) PROTECTIONS:**

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

**VII) OTHER FEATURES:**

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.  
The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About solar pump
  - (c) About PV module
  - (d) About motor pump set
  - (e) Clear instructions about mounting of PV module.
  - (f) About electronics used in AC motor pump sets, if any
  - (g) DO sand Donds,
  - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
  - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales

service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User / MEDA.

**4) ii) SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS (AC Pumps)**  
(PV Module with a provision of single axis manual tracking only)

**A) SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS (with 900 watt SPV Modules)**

**I. DEFINITION**

A Solar Photovoltaic water pumping system consists of a PMDC surface mounted motor, pump set, controller, electronics, interconnect cables, an MCB and a Solar PV array mounted on a suitable GI structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the SPV water pumping system.

**II DUTY CYCLE**

The solar PV water pumping system should provide a minimum of 77 liters of water per watt of PV array used per day under average daily solar radiation conditions of 5.5 KWh/sq.m. on a horizontal surface, from a total head of 10 meters (suction head up to a maximum of 7 meters). In case of deep well submersible pumps, the water requirement should be a minimum of 25 liters of water per watt of PV array capacity used per day from a total depth of 30 meters. Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is permitted. The manufacturer of SPV water pumping system is required to specify whether the minimum water output is achieved directly or through tracking of PV array. The actual duration of pumping of water on a particular day and the quantity of water pumped may vary depending on the location, season etc.

**III PV ARRAY CAPACITY**

The SPV water-pumping system should be operated with a PV array in the range of P max = 900 watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. In case of thin film solar cell modules, the specified values of output power refer to the power output achieved after the initial degradation.

**IV MOTOR PUMP-SET**

Following type of motor pump sets are permitted to be used in the SPV water pumping systems:

Surface mounted three phase AC motor pump-set of appropriate ratings which will deliver highest output from given SPV wattage.

**V PROTECTIONS:**

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

## **VI OTHER FEATURES:**

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.  
The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About solar pump
  - (c) About PV module
  - (d) About motor pump set
  - (e) Clear instructions about mounting of PV module.
  - (f) About electronics used in AC motor pump sets, if any
  - (g) DO sand Donqs,
- (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
- (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

**B) SPECIFICATIONS for Submersible pump for Bore well (900 Wp Pump) (900 WATT PV Module) for giving 5000 LPD vs. 90 m head @ 5.5 kWhr / Sq.m. / day solar irradiation incident in Maharashtra.**

**I) Submersible pump**

Light weight stainless steel pump and body  
Option for operating head from 15-90 m  
Discharge 5000 LPD @ 90 m  
Rated speed 500-3600 rpm  
Current 9.5 amps (maximum)  
Cable 3 X 2.5 sq.mm  
Suitable for 100 mm and above dia.  
Bore wells Outlet size 32mm

The overall efficiency of the pump at 10 meter total head should be at least and the efficiency of the submersible pump should not be less than 50%.

**II) PV ARRAY CAPACITY:**

The SPV water-pumping system should be operated with a PV array of P max = 900 watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. The PV module shall contain mono / multi crystalline silicon / thin film amorphous silicon solar cells. The PV module shall be as per IEC 61215 / IEC 61646 (revised) specifications or equivalent national or international standards.

**III) MOUNTING STRUCTURES & TRACKING SYSTEM:**

To enhance the performance of Solar Hand pumps covered under the program, it is must to use a tracking system. Manual 3 position tracking is must. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 200 km per hour. The support structure used in the pumping system will be hot dip galvanized.

**IV) CONTROLLER & PROTECTIONS:**

Solar Power Conditioning Unit (SPCU) for AC submersible pumps: Proper inversion technology for converting solar DC to three phase AC at highest efficiency and suitable for driving inductive load such as motor. It should also incorporate the mechanism by which Maximum Power Point Tracking (MPPT) is achieved. (Digital Signal Processed Maximum Power Point Tracking to monitor the change in voltage & input power level and automatically adjust the motor speed with varying Sun Intensities to ensure maximum power extraction at all Sun intensities and thus, optimum water output from the pumping system.)

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit, reverse polarity, under voltage, over voltage, ambient of 55

deg C, accidental wire cuts should be provided. The solar power conditioning unit (SPCU) / controller should incorporate following features;

**1. Electronic Sensor less Dry running protection:**

The pump set is protected against dry running to prevent damage to the pump and motor. Dry run protection is inbuilt in the inverter based on power / current sensing.

**2. Automatic start and stop:**

The controller starts automatically in morning time sufficient sun intensity is available and should stop automatically in evening in case of low sun intensity. It should also start and stop automatically during cloud passing.

**3. Soft starting:**

The controller provides for soft start to control in-rush current, which prevents damage to the motor.

**4. The controller has sufficient protection against faults like over voltage, under voltage, overload, phase imbalance and Output short circuit protection.**

**5. The controller does not re-start automatically in case of faults like dry run, phase imbalance, output short circuit; unless attended.**

**6. Work satisfactorily at an ambient temp. </= 55<sup>0</sup> Cent.**

**V) OTHER FEATURES:**

- i) A good reliable circuit breaker suitable for Solar DC use is to be provided with the motor pump set. Sufficient length of cable should be provided for interconnection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.  
The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About solar pump
  - (c) About PV module
  - (d) About motor pump set
  - (e) Clear instructions about mounting of PV module.
  - (f) About electronics used in AC motor pump sets, if any
  - (g) DO sand Don'ts,
  - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
  - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.

- v) The PV module (s) will be guaranteed for performance for 25 years as per IEC and warranted against manufacturing defects for a minimum period of 5 years from the date of supply. The complete Hand pumping system will be warranted for a minimum period of two years from the date of installation and its solar part will be guaranteed as given above for solar PV modules, whereas pump part will be guaranteed for 5 years.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

- vi) Any additional works like construction of storage tank, stand post, distribution system, etc. which are not covered above, but necessary for the functioning of the system and required components of the system shall be scope of purchaser / user.

**C) Specifications for Spv Water Pumping Systems for Capacity of 2 H.P. (Spv Pump) (1800 Watt Pv Module) for giving 10000 LPD vs. 90 m head @ 5.5 kWhr / Sq.m. / day solar irradiation incident in Maharashtra.**

**I) Submersible pump**

Light weight stainless steel pump and body  
2 H.P., 1800 W submersible pump  
Operating head 90 m  
Discharge 10000 LPD @ 90 m  
Suitable for 100 mm and above dia.  
Pump Outlet size 50mm

The overall efficiency of the surface pump at 10 meter total head should be at least 40% and the efficiency of the submersible pump should not be less than 35%.

**II) PV ARRAY CAPACITY:**

The SPV water-pumping system should be operated with a PV array of P max = 1800 watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. The PV module shall contain mono / multi crystalline silicon / thin film amorphous silicon solar cells. The PV module shall be as per IEC 61215 / IEC 61646 (revised) specifications or equivalent national or international standards.

**III) MOUNTING STRUCTURES & TRACKING SYSTEM:**

To enhance the performance of Solar Hand pumps covered under the program, it is must to use a tracking system. 3 position Manual tracking are permitted. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 200 km per hour. The support structure used in the pumping system will be hot dip galvanized.

**IV) CONTROLLER & PROTECTIONS:**

Solar Power Conditioning Unit (SPCU) for AC submersible pumps: Proper inversion technology for converting solar DC to three phase AC at highest efficiency and suitable for driving inductive load such as motor. It should also incorporate the mechanism by which Maximum Power Point Tracking (MPPT) is achieved. (Digital Signal Processed Maximum Power Point Tracking to monitor the change in voltage & input power level and automatically adjust the motor speed with varying Sun Intensities to ensure maximum power extraction at all Sun intensities and thus, optimum water output from the pumping system.)

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit, reverse polarity, under voltage, over voltage, ambient of 55

deg C, accidental wire cuts should be provided. The solar power conditioning unit (SPCU) / controller should incorporate following features;

**1. Electronic Sensor less Dry running protection:**

The pump set is protected against dry running to prevent damage to the pump and motor. Dry run protection is inbuilt in the inverter based on power / current sensing.

**2. Automatic start and stop:**

The controller starts automatically in morning time sufficient sun intensity is available and should stop automatically in evening in case of low sun intensity. It should also start and stop automatically during cloud passing.

**3. Soft starting:**

The controller provides for soft start to control in-rush current, which prevents damage to the motor.

**4. The controller has sufficient protection against faults like over voltage, under voltage, overload, phase imbalance and Output short circuit protection.**

**5. The controller does not re-start automatically in case of faults like dry run, phase imbalance, output short circuit; unless attended.**

**6. Work satisfactorily at an ambient temp. </= 55<sup>0</sup> Cent.**

**V) OTHER FEATURES:**

- i) A good reliable circuit breaker suitable for Solar DC use is to be provided with the motor pump set. Sufficient length of cable should be provided for interconnection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.  
The following minimum details must be provided in the Manual:
  - (a) About Photovoltaic
  - (b) About solar pump
  - (c) About PV module
  - (d) About motor pump set
  - (e) Clear instructions about mounting of PV module.
  - (f) About electronics used in AC motor pump sets, if any
  - (g) DO sand Don'ts,
  - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
  - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.

- v) The PV module (s) will be guaranteed for performance for 25 years as per IEC and warranted against manufacturing defects for a minimum period of 5 years from the date of supply. The complete Hand pumping system will be warranted for a minimum period of two years from the date of installation and its solar part will be guaranteed as given above for solar PV modules, whereas pump part will be guaranteed for 5 years.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

- vi) Any additional works like construction of storage tank, stand post, distribution system, etc. which are not covered above, but necessary for the functioning of the system and required components of the system shall be scope of purchaser / user.

**5) TECHNICAL SPECIFICATIONS FOR SUPPLY AND INSTALLATION OF COLOUR TV**

The Manufacturers have to supply Photovoltaic Colour TV with following technical specifications: -

- i) 150 Watt Peak PV Module
- ii) 230 VAC, 52 CM Flat screen colour TV- 1 No., Make: Standard
- iii) Charge controller . 1 No.
- iv) Inverter - 220 VA.
- v) Battery - 12 V, 150 AH. Make: Exide/Any approved
- vi) Running hours - 4 per day.

**6) SOLAR EDUCATIONAL KIT**

Solar Education Kit has minimum 5 watt capacity solar panel and which demonstrates the various applications and working procedures of photovoltaic devices such as conversion of solar energy into electrical, mechanical, electromagnetic, sound energy, Heat Energy by the way of demonstrating working of LED light, Motor, Relay, Alarm bell , Resistance Heating. This is used to create awareness amongst students about various applications of Solar Energy. The knowledge of different type of electronic circuits is spread through the educational kit, which activates the electronic circuit using solar energy. It contains Analog Voltmeter and Ammeter for measurement purpose. Solar Education Kit must be handy and supplied with User Manual. The digital multimeters of reputed make may be provided instead of analog meters in education kit.

**7) SOLAR DESALINATION SYSTEM (Solar Still)**

Capacity of the system	- 3 Lpd
Type	- Portable
Size	- 1 X 1 m
Material	- Fibre Reinforced Plastic
Thickness of body	- 3 mm.
Glass thickness	- 4 mm. Toughened glass
Transmittivity of Glass	- 0.85
Support Stand duly painted	- M.S. 25X 25X3 mm.
Plastic cane	- 5 liter capacity
Rubber/Plastic tube	- Suitable size and length to connect till with plastic cane
Output capacity	- 2 - 3 Lpd

**8) Technical specifications of Solar Dryer: -**

Sr. No.	Technical Conditions
1.	Type: Manufacturing, supply, installation & commissioning of solar dryer of 5 kg per day drying capacity per day for drying agriculture product i.e. Potato, Onion, spinach, Amla, Chilly etc. in the state of Maharashtra.
2.	Solar dryer shall of MS / Fibre Reinforced Plastic or equivalent material
3.	Tray shall be of wooden with stainless steel net or of complete stainless steel material
4.	Top cover shall be of 4 mm thick. Toughened glass having transmittivity of minimum 85 percent
5.	Support stand shall be of M.S. of required size

## **9) SOLAR POWER FENCING**

### **I. DEFINITION**

A solar fencing system is a fencing system to protect any village or campus from unwanted elements, especially from wild animals. The principle involves the passage of series of electric pulses every 1 to 1.2 seconds, through galvanized wires of the fence. The electric pulses are emitted by the energizer unit at a very high voltage. These energizers are designed to operate on batteries which are charged by solar energy. When an animal touches the fence, it closes an electric circuit by earthing and an impulse, which lasts for 3 milli seconds, travels through the body of the animal causing sudden muscular spasms. This jolt is painful but not fatal to the life of the animal. Having experienced the shock, human or wild/domestic animal do not dare to negotiate the fence again.

### **II. BASIC PARAMETERS OF FENCING:**

Maximum distance between two sections posts	: 150 Meters
Distance between two intermediate posts	: 6 Meters
Nos. of lines of wires	: 5 No. or 8 No.
Minimum height of the fence	: 7 Feet
Energizer capacity	: 3 Kms per energizer

### **IV. ENERGIZER**

Should be battery operated with solar panel option to recharge the battery. It must confirm to all National and International Standards of safety and should not be fatal to human and animal life. Output characteristic of the energizer should be as follows:

O/P Voltage at 50 K load	: not more than 10 KV
O/P Energy	: 3.5 J minimum
Pulse duration	: 0.01-3.00 mile Sec
Pulse interval	: 1.1 - 1.4 Sec
Peak current	: 7.0-8.0 Amp High
RMS current	: 2.4-2.8 Amp High
Charge	: 1.0-1.4 m C High
Fib Energy	: 3.5-4.5 MCA High

### **IV. OTHERS**

- a) The system should ensure good shock ability at the beginning and end of the fence.
- b) The ground to earth voltage must be not more than 200 volts.
- c) The minimum Zinc coating thickness for all galvanized steel components must be 25 microns.
- d) The contactor shall provide five copies of Operation & Maintenance manual for every project installed. This shall be in Hindi. The manual must contain- Details about solar power fence

Clear instruction about maintenance and troubleshooting etc

DO's and DON'Ts.

Relevant details and drawing for regular maintenance

Details of contact person in case of non-functionality of systems

**V. TECHNICAL SPECIFICATIONS AND REQUIREMENTS OF VARIOUS COMPONENTS**

<b>Component</b>	<b>Specification</b>	<b>Remarks</b>
<b>Base Unit</b>		
Energizer (Model-1)	Must switch to high, medium and low power setting. Full and reduced power output terminal.	Should be according to IS Safety code. (As per BIS standard)
Energizer (Model-1) (If required)	Must have display panel on the equipment to provide fence performance information. Must have in-built adaptive control feature with provision for inclusion of alarm autodialing facility/ GSM facility. Must have provision for Remote Control Operation.	Should be according to International Electro Technical Committee which fulfills BIS standard.
Solar PV Module	37 Watts, 12 Volts rating with minimum 10 years warranty against manufacturing / performance defects. The terminal box on the module should have a provision of opening it for replacing the cable, if required.  a) Module shall contain crystalline silicon solar cells. b) Model and / or Type No. c) Serial No. d) Year of manufacture	Any MNRE approved module with a satisfactory test report from MNRE approved test Center. A blocking diode should be provided to prevent reverse flow of current through the PV module, if such a diode is not provided with the module itself.
Lighting diverter	Must be capable of diverting stray lightening. The diverter assembly must be adjustable for spark gaps. Adequate earthing Must be provided. Must have good insulation.	With proper earthing system
Housing box with post	Made of 16 gauges G1 sheet, painted and fixed on 100 NB, class B Pipe, and must be grouted. Should be capable of safety housing battery and energizer.	Must confirm to I.P. 66 specifications.
Module stand	Must be made of angle iron, strips and 50 NB pole. Hot dip galvanized to minimum of 30 microns Zinc coating thickness. Must have a provision to tilt the solar module 10 to 30 degrees with horizontal. To be grouted properly.	To suit PV module
Battery	12Volts, 100 Ah tubular/ plate, flooded electrolyte, low maintenance battery with 2-year guarantee.	Exide or equivalent standered make
<b>Accessories</b>		

Earthing System	At least 4 feet long, 8-mm.dia stainless steel rods of non-rusting quality. Must contain earth mixture, capable of retaining moisture.	Should be capable of providing proper earthing to the system.
Strain Insulators	Must be of polycarbonate material and should withstand 15 KV voltages.	Rainwater run-off should be provided on the insulator. Should be UV stabilized.
Strap Insulators /T post insulators	Must be of virgin plastic material . Polyethylene with locking facility. Designed to collapse at a load of 40 kgs thus ensuring alarm trigger.	Should be UV stabilized
High tensile wire	High tensile 2.5 mm. dia galvanized steel wire with minimum	UTS 140.5 kg/mm2,
Wire lighteners	Made of non-rusting quality Aluminum alloy.	For proper tightening and tensioning of wires.
Tension springs	Spring steel capable of taking compression loads.	Galvanized
Joining Clamps	Positive locking mechanism. With Zinc coating of more than 25 microns.	Standard make approved by govt.
Warning sign Boards	Polyethylene plastic with statutory colors and signs	Yellow with black lettering in local language
Lead out cable	Must be double insulated to withstand 15 KV voltages. Inner core wire must be hot dipped galvanized.	For under gate and base unit connections.
Rope gate kit	Steel ropes with handles and spring assembly. Handles must be made of polyethylene.	Length of rope to suit gate width.
Fabricated gate	6.5 feet high Double wing 4 Meter wide gates for vehicles and single swing 1 Meter wide gate for human movement with provision for energizing and locking the gates.	Standard make approved by govt.
Tool kit	Should contain: Wire tightened handle, Twisting tool, pliers, Double ended spanner for clamp tightening & screw drives	Standard make approved by govt.
Drop chains	12.5 mm loop size made of 12 gauge M.S. Wire	For rivers and streams
Flood gate controller	Should be capable to automatically cut off the current in drop chains, in case of floods.	To be used with drop chains
Cut out switch	Should be temper proof & capable of withstanding high voltage from energizer with a provision to switch off power of a section of the fence.	Removable key to switch off power.
Elephant toupees	2.5 mm dia galvanized iron wire and G.I. Clamps should be used.	For protection of posts from elephants.

<b>Posts</b>		
Section/ Corner / End / Pull through posts	50 NB class Bqpipe, 8.5 feet long, hot dip galvanized to more than 60 microns. Stay support 25-mm. diameter hot dip galvanized	1.5 feet length of the posts must be grouted in 2X2X2 feet size P.C.C. in 1:2:4 cement sand & stone ballast.
Intermediate posts	8.5 feet long, 25X25X3mm size T section post, galvanized to more than 60 microns	To be inserted 1.5 feet deep in ground.
<b>Testing equipments</b>		
Digital volt meter	Must display fence voltage digitally up to 12 KV. Auto ON/OFF switch should activate when fence pulse is detected. Body must be electric resistant, waterproof with impact resistant case.	Must display fence voltage in 100 V increments under 10 KV and in 1,000 V increments, from 10 KV to 12 KV
Xeon flash tube	Must be capable of flashing with each pulse to monitor the fence.	Must be visible from a distance of 1000 meters.
Neon tester	Must be with 5 Neon lights, measuring the fence for excellent, very good and poor and not working grading.	Should be made of tough and durable ABS plastic.

## **10) SPV HOARDING SYSTEM**

### **• INTRODUCTION**

In this world of fierce competition all most every company is fighting for the mind share of its customers. Outdoor advertising is one such, means of communication, which is very common amongst the advertisers to display their products. A considerable amount of energy is required for illuminating advertising hoardings during the nighttime. SPV based (back lit type) hoardings may reduce this consumption by replacing the conventional hoarding lighting with non-conventional energy' source. This system may prove to be of special relevance in case of remote areas such as highway where providing electricity by conventional means will be very costly and will involve lot of losses.

### **• SYSTEM CONFIGURATIONS AND OPERATION**

Solar Photovoltaic (SPV) Hoarding System comprises of the following items:

- Solar Photovoltaic Module.
- Battery Bank.
- Inverter cum Charge Controller
- Mounting structure, wire, cables etc

The operation of the system is automatic and the system is switched ON in the evening and switched OFF after six hours of operation.

### **• TECHNICAL SPECIFICATIONS**

The technical specifications of 962 Wp to 1000 Wp SPV Power Pack for providing power to 18 nos. of , 24 W (4 ft tubes) load for hoarding (back lit type) of size 40ft X 20 ft. for 6 hrs. operation comprises of following:

SPV Modules	: 13 nos. of 74 Wp SPV Modules or 10 nos. of 100 watt Crystalline Silicon type fitted with by pass diodes
Module mounting structure	: 1 set Made of MS, duly galvanized to avoid corrosion. Suitable to accommodate necessary SPV Modules. The structure shall be suitable to be installed along with the hoarding. There shall be no provision of tilting.
Battery Bank	: 48V, 300 AH Lead Acid Tubular comprising of 24 nos. of 2 V, 300 AH cells- the battery bank shall be low maintenance type
Inverter cum Charger	: 1 kVA inverter along with charger suitable for charging the battery bank through 962 W to 1000 W SPV array.

## **11) SPV ROAD STUDS**

### **• INTRODUCTION**

Solar Road studs are unique, innovative and state of the art road safety devices for night time drivers. The solar road studs, powered by energy from the Sun, provide a clear, visible traffic guidance round the year irrespective of weather conditions. These studs function automatically from dusk to dawn. This device may be deployed on highway, zebra crossing, speed breakers, chandeliers, construction sites, petrol pumps, resorts, farm house, hotels, warning signs on 'sea sides, remote islands, riverside roads near water ways and embankment etc.

### **• SYSTEM CONFIGURATIONS AND OPERATION**

Solar Photovoltaic (SPV) Road Stud comprises of the following items:

- Solar Photovoltaic Module.
- Battery.
- Light Source

The operation of the system is automatic and the system is switched ON in the evening (Dusk) and switched OFF in the morning (Dawn). .

### **• TECHNICAL SPECIFICATIONS**

The technical specifications of solar Road studs are as under:

SPV Modules	:	2.4 V / 0.15 -0.3 W
Battery Bank	:	Ni-Mh, Rechargeable battery 1.2V/1200 mA
Light Source	:	6 pcs super bright LEDs
Light Intensity	:	6000 - 8000 mcd
Material	:	Aluminum Alloy
Bearable Weight / Load	:	9 tons
Working Time	:	50-60 hrs after full battery charging
Charging Time	:	5-6 hrs
<b>General Conditions</b>		a) Visible from up to 750 meters in adverse weather & even during night. b) Rugged / Sturdy Design to withstand high intensity load. c) Maintenance Free & environment friendly. d) Gives Bi directional light. e) Protection: Weather proof IP 65. f) Material of construction: Cast Aluminum g) Light Source: High Power light Emitting Diodes with Approx life of around 100000 hrs. h) Top cover made of clear poly carbonate material. i) Automatic Dusk to Dawn Solar Switching. j) Autonomy of 3-4 days if no sunlight for 4 days.

## **12) SOLAR POWERED BLINKER / OBSTRUCTION WARNING LIGHT**

Tap the Earth's Oldest Energy Source. The SUN-to illuminates your patio, lawn, driveway, walkway or use as obstruction light.

Solar Powered Light can easily be installed at any place under the sun. The Ni-cd / Ni-mh batteries are charged thru the Sun's energy during the daytime and powered the super bright LEDs in the evening. The light switched ON automatically at Dusk and Switched Off at the dawn through the inbuilt State-of-The-Art circuit. The control circuit charged and protects the battery as per the recommended specifications of the battery.

The lamp is designed with Super Bright RED/YELLOW/White LED bulbs to provide brighter light and longer operating -Hours. The also features a new diffract lens technology that disperses the light evenly.

Entirely stand-alone & weather proof, a Solar Powered Light incorporates the world renowned Crystalline Solar Panel, discretely positioned on top of the lamp body which collects energy during the day from sunlight. The light can be installed anywhere within few minutes.

The light is available in different models:

### **TECHNICAL SPECIFICATIONS FOR SOLAR BLINKER**

Each blinker will be provided with 37 W peak module capacities and will remain operational for 24 hrs. The blinker will be LED based which will be proposed as a speed indicator. Indication of various signs should be displayed on the blinker.

#### **Single Aspect Solar Blinker (Continuous blinking 50% duty cycle)**

Solar Panel :

Type: Crystalline silicon

Rating: 2 x 18Wp or 1 x 37 Wp

Mounting: Adjustable MS frame

Charge Regulator: High efficiency PWM MosFET controlled

Battery: 24V, 40Ah Sealed Maintenance free

System Voltage 24V

Flash rate: 45 flashes + 10 flashes per minute

LEDs: Super bright in 200mm aspect

Controller box: Corrosion proof FRP

Pole: GI pole 4 m, OD 3 in.

Foundation: Concrete foundation 1:2:4

Autonomy: 1 day no sun

Operation: 24 hours under clear/sunny conditions

**13) TECHNICAL SPECIFICATIONS FOR 1 KWP SOLAR POWER PACK**

Sr.No.	Item & Description	Qty.
•	<b>Solar PV Module Array – 1036 Wp (74 x 14 Nos.)</b> ➢ Rating 1036 W (74 Wp x 14 Nos. or equivalent) Mono or Poly Crystalline silicon	1 set
•	<b>Solar array junction box</b> ➢ Weather proof junction box ➢ Blocking diodes ➢ String indicators	1 set
•	<b>Solar Array Mounting Frame</b> ➢ Fabricated in GI angle and square tube section ➢ Manual tracking facility	
•	<b>Battery Bank 24V, 600 Ah</b> ➢ Lead acid, Tubular plate; C/10. ➢ Typical Discharge Characteristic Curve as per IS:1651-1991 ➢ Battery stand	1 set
•	<b>Solar + Mains Charge Controller -</b> ➢ 24V, 35A; MOSFET based PWM controlled; ➢ Efficiency 92% ➢ Indications . Solar ON, Charging ON, Battery Low, Battery state of charge, Mains ON ➢ Protections . Battery over charge, Battery deep discharge, battery and solar array reverse connection, output short circuit. ➢ Output Over /under voltage Output short circuit ➢ 24V , 5 SMPS based mains charger ➢ Manual changeover between solar & mains charger	1 set
•	<b>Inverter 1250 VA , 24 V</b> ➢ I/P 24 VDC ; O/P: 230 VAC, 50 Hz ➢ True sine wave power corrected output ➢ Load regulation 2%, power factor : 0.8 ➢ Protection: Output over load, output short circuit, earth fault ➢ Indications : input and out put voltage and current, Output short circuit / trip LED indications ➢ Manual Changeover to Grid in case of failure / Trip condition	1 set
•	<b>DC + AC Distribution consisting of:</b> ➢ Battery isolator ➢ Solar array isolator ➢ Output isolator ➢ Output AC ON indication lamp ➢ Energy meter for accounting the energy generated	1 set
•	Cabling & Hardware ➢ Panel interconnection; Battery inter connection; System wiring, Wiring up to distribution board ➢ Wires of appropriate cross section . <del>ISI</del> marked ➢ All hardware for external applications should be of stainless steel.	1 set
•	GI Pipe Earthing System conforming IS:3043 . 1966	1 set
•	Lightning & Over Voltage Protection System conforming provisions of IS:2301. 1969	1 set

## **14) 1 kWP BIPV SPV POWER PLANT**

### **INTRODUCTION**

Building Integrated Photovoltaic (BIPV), or Rooftop SPV Power Plants are getting wide acceptance in urban area as the SPV modules are installed in place of the roof of the building. BIPV Grid Interactive Power Plants should have provision to export the excess power (which is not utilized in the building) to the Grid. Grid Interactive BIPV Power Plants also serve the purpose of peak load shaving in peak hours when the load on the state grid is high. The installation of BIPV Power Plants could save the cost on accounts of :

- Cost of land and
- Cost of civil work for foundation of Spy modules mounting structure

### **SYSTEM CONFIGURATION AND OPERATION**

BIPV Power Plant comprises of the following items:

- Solar Photovoltaic Modules as per capacity.
- Power Conditioning Unit
- Battery Bank - 24 V, 600 Ah

(In case of Building Integrated Photovoltaic System, the use of battery bank is mandatory only if the regular Crystalline Modules are used similar to the Rooftop Solar Power plant. But it is expected that the manufacturer has to install the glass to glass fitted SPV module which can be fitted (without battery) in such a way that it seems to be the integral part of the building.)

- Metering and monitoring arrangement
- DC and AC Distribution panels.

The BIPV Power Plant is designed with the purpose of exporting net excess electricity to the state grid. The Spy modules convert sun light in to DC Power and the Power Conditioning Unit (Inverter) converts the DC Power to AC power suitable to *feed* the same to the grid. Apart from conversion from DC to AC the function of Power Conditioning Unit is also of synchronization with the grid. It monitors the voltage, frequency, phase angle etc. of the grid and accordingly exports energy. The Power Conditioning Unit also has the unique function of Maximum Power point Tracking (MPPT). The operation of the systems is fully automatic, i.e. it automatically starts exporting power in the morning when the Sun rises and the solar isolation level reaches the minimum level and it stops exporting power in the evening and goes to sleep mode. Approval of other bodies for connection etc. if required shall have to be arranged by the bidder with the help of user.

## **15) TECHNICAL SPECIFICATIONS FOR SOLAR TRAFFIC SIGNAL**

Conventional Traffic Signals using incandescent Lamps consume high quantum of electrical energy. The failure of lamps, fading of the reflectors, need of 230 V A C mains power, frequent maintenance are major constraints in their operation. Beside this, during power failure the traffic chaos and strain on the traffic police is a very serious matter calling need for remedial.

The frequent failure of the lamps causes confusion to the traffic and the fading of the reflector cause drastic luminous depreciation leading to poor visibility of signal. All this associated with the phantom effect can mislead the traffic to identify the signal status resulting into accidents and/ or conflict with traffic police.

The replacement costs of above components and the labour costs make the system maintenance very expensive in addition to heavy electricity bills. In short by sing conventional old technology, we not only invite trouble factors associated with serious inconvenience but also pay very heavy costs on all fronts.

### **• FEATURES**

- Ultra low power consumption.
- User friendly programmable controller.
- Operating Voltage 60 VDC to minimize  $I^2 R$  losses.
- Multiple Programming facility for Peak - Slack Hours and Blinker mode.
- Auto - Manual / Blinker Selection.
- Communication Port for Synchronized linking.
- High contrast visibility even in misty & foggy weather.
- Power consumption less than 5 Watts/ lamp head.
- Emitted Energy is 100% light. No Heat generation.
- Practically maintenance free.
- Light output is sufficient even if few LEDs fail.

### **• SPECIFICATIONS:**

- Designed for 3, 4 Road Junctions.
- Powered by Solar & Grid power.
- 450 Wp PV Modules for 3 Road Jn & 600 Wp PV Modules for 4 Rd Jn
- 24V, 300 Ah SMF Battery for 3 Rd Jn & 400 Ah SMF Battery for 3 Rd Jn up to 10 hrs back-up provided
- Micro Controller Based signal controller, site programmable.
- 3 Digit Count Down timer LED aspect provide long life and great visibility (> 500 mtrs.)